TRANSLATION FROM JAPANESE

(19) Japanese Patent Office (JP)　(12) Unexamined Patent Gazette (A)　(11) Unexamined Patent Application

(Tokkai Hei) No. **9-152466**

(43) Disclosure Date: June 10, 1997

(51) Int. Cl.⁶	Class Symbols	Internal Office Registr. Nos.	F I	Technical Display Location
G 01 R 31/26			G 01 R 31/26	Z H

Request for Examination: Not submitted　Number of Claims: 3　OL (Total of 9 pages [in original])

(21) Application No.: Tokugan Hei 7-314252

(22) Filing Date: December 1, 1995

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(54) [Title of the Invention]

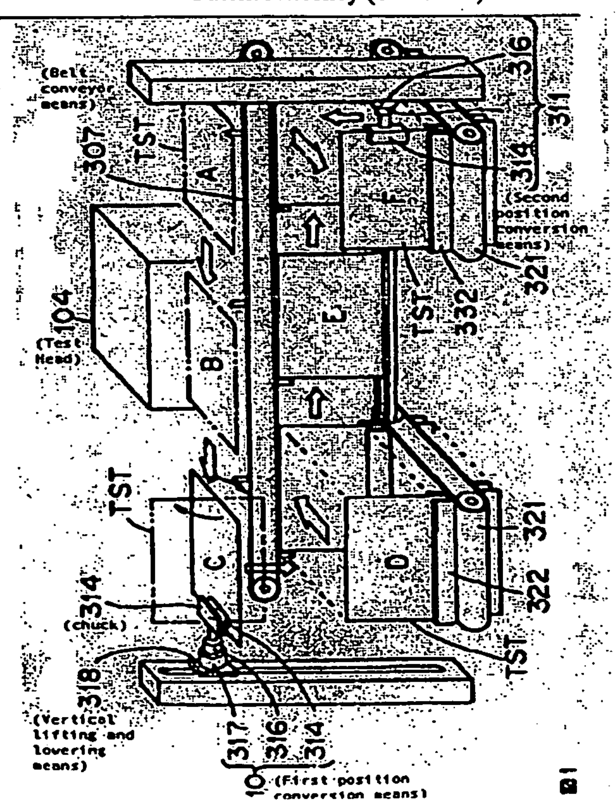
IC Testing Method and Device

(57) [Summary]

[Object] To provide an IC testing method and device thereof that is low in height and for which the test head can easily be pulled to the outside.

[Structure] Proposed is an IC testing method and testing device that perform IC testing by holding a test tray that holds ICs in a vertically standing position, with test head 104 contacting the ICs in that vertical position, and also proposed is an IC testing method and a device that uses this method that is low in height and for which the test head p sition can be installed at a low position.

Figure 1



[Claims]
[Claim 1] For an IC testing device which has a structure for which multiple ICs from a general purpose tray are placed flat on a test tray which has been sent to the loader unit and is in a stopped state, this test tray is sent to a constant temperature bath that is provided adjacent to the aforementioned loader unit, at the constant temperature bath, heat stress of a desired temperature is applied to the ICs in the constant temperature bath while the aforementioned test tray is moved to a test chamber provided adjacent to the constant temperature bath, IC operation is tested by having a test head provided in the test chamber electrically contact in sequence the ICs held in the aforementioned test tray, recording those test results for each IC, moving the aforementioned test tray to the heat removal bath provided adjacent to the test chamber, and removing the high temperature or low temperature given in the aforementioned constant temperature bath at the heat removal bath, while the heat removed test tray is brought out to the unloader unit, and at this unloader unit, the ICs held in the aforementioned test tray are sorted according to the aforementioned recorded test results, and these are moved to general purpose trays divided into good items and defective items, wherein the IC testing method is characterized in that the aforementioned constant temperature bath, test chamber, and temperature removal bath are placed in a row, the aforementioned test trays are moved in a vertically standing position in the constant temperature bath, test chamber, and heat removal bath, and testing is performed by having a test head in a vertically standing position contact the ICs to be tested.
[Claim 2] The IC testing method of claim 1, wherein for the IC testing device, a first position conversion means that converts the test trays that are in a horizontal position to a vertical position is provided between the aforementioned loader unit and constant temperature bath, and a second position conversion means that converts the vertical position test trays to a horizontal position is provided between the heat removal bath and the unloader unit.
[Claim 3] The IC testing device of claim 1 or 2, wherein the IC testing device has a structure such that the test head is inverted from the testing device, and this is pulled outside the device in a position with the contact area of the IC to be tested with the aforementioned test head exposed upward.

[Detailed Description of the Invention]
[0001]
[Technological Field of the Invention] The present invention relates to an IC testing method used when testing semiconductor integrated circuit components (hereafter referred to as ICs). More specifically, this is an invention in the technical field of so-called handlers which convey ICs, make electrical contact with test heads, perform testing at the main testing device, and after testing, convey the IC from the test head, and divide the ICs into good items and defective items based on the test results.

[0002]
[Prior Art] We will explain the overall structure of a prior art IC testing device using figures 7 through 13. Figure 7 shows a schematic lenear planer. In the figures, item 100 is a chamber that contains a test head, 200 is an IC storage area that stores ICs to be tested or already tested ICs that have been sorted, 300 is a loader unit that sends ICs to be tested to chamber 100, 400 is an unloader unit that takes out sorted ICs that have been tested in chamber 100, and TST is a test tray for conveying ICs, whereby the test tray is stacked with ICs to be tested at loader unit 300, sent to chamber 100, the ICs are tested in chamber 100, and the tray carries already tested ICs to unloader unit 400.

[0003] Chamber 100 is composed of a constant temperature bath 101 that gives the target high or low temperature stress to ICs to be tested that are stacked in test tray TST, test chamber 103 that has a test head contact ICs which have been given heat stress by this constant temperature bath 101, and heat removal bath 103 that removes the given heat stress from ICs tested in test chamber 102. Specifically, when a high temperature is applied at constant temperature bath 101, cooling is done by an air blast, items are returned to room temperature and transported to unloader unit 400. When a low temperature such as −30 °C is applied at constant temperature bath 101, items are heated using hot air, a heater, etc., then the items are returned to a temperature at which condensation will not occur, and transported to unloader unit 400.

[0004] Constant temperature bath 101 and heat removal bath 103 are installed projecting upward from test chamber 102. As shown in figure 8, substrate 105 is extended between constant temperature bath 101 and heat removal bath 103, test tray conveyor means 108 is mounted on this substrate 105, and test tray TST is moved from heat removal bath 103 toward constant temperature bath 101 by this test tray conveyor means 108. Test tray TST is stacked with ICs to be tested at loader unit 300, and is carried to constant temperature bath 101. A vertical conveyor means is mounted on constant temperatur bath 101, and multiple test trays TST are supported

by this vertical conveyor means, waiting until test chamber 102 becomes empty. During this waiting period, high temperature r low temperature stress is applied to the ICs to be tested. Test head 104 is placed in the middle of test chamber 102, test tray TST is carried over test head 104, and test head 104 lectrically contacts the ICs to be tested to test them. Test tray TST for which testing has ended undergoes heat removal at heat removal bath 103, the IC temperature is returned to room temperature, and the tray is output to unloader unit 400.

[0005] Provided in IC storage area 200 are stocker for ICs to be tested 201 that stores ICs to be tested and stocker for already tested ICs 202 that stores ICs sorted according to test results. General trays KST that store ICs to be tested are stacked and held in stocker for ICs to be tested 201. This general purpose tray KST is carried to loader unit 300, and from this general purpose tray KST carried to loader unit 300, ICs to be tested are stacked into test trays TST that are stopped at loader unit 300. As shown in figure 8, as an IC conveyor means that carries ICs from the general purpose tray KST to the test tray TST, it is possible to use the X-Y conveyor means 304 that is composed of two rails 301 that are installed on top of substrate 105, a movable arm 302 that can go back and forth (this direction is the Y direction) between test tray TST and general purpose tray KST using these two rails 301, and movable head 303 that is supported by this movable arm 302 and can move in the X direction along movable arm 302. A downward facing suction head is mounted on movable head 303, this suction head moves while sucking air, suctions the ICs from general purpose tray KST, and carries the ICs to test tray TST. A number such as eight of these suction heads can be mounted on movable head 303, allowing eight ICs at a time to be carried to test tray TST.

[0006] Also, an IC position correction means 305 called a precisor (figure 8) is provided between the position at which general purpose tray KST is set and test tray TST. This position correction means 305 has a relatively deep recess, and ICs suctioned onto the suction head are dropped into this recess. The edge of the recess is enclosed by a sloped surface, and the dropping position of the IC is regulated by this sloped surface. Therefore, the relative position of the eight ICs is regulated, and the ICs for which the position has been regulated is again suctioned onto the suction head and transferred to test tray TST. Specifically, the recess that holds ICs at the general purpose tray KST is formed to be larger than the shape f the ICs. Because of this, there is a great deal f variance in the position f the ICs stored in general purpose tray KST. If these are carried to test tray TST directly after being suctioned to the suction head in this stat , it will not be possible to directly drop the ICs into the IC storage recess formed in test tray TST. Because of this, a position correction means 305 is provided, and the IC alignment precision is matched to the alignment precision of the IC storage recess formed on test tray TST.

[0007] Figure 9 shows the structure of test tray TST. For test tray TST, multiple rails 13 are formed in parallel and at even intervals on rectangular frame 12, multiple attachment pieces 14 are formed projecting at even intervals at both sides of these rails 13 and at edge 12a of frame 12 facing rails 13, and carrier storage area 15 is arranged and formed by two attachment pieces 14 between these rails 13 and between rails 13 and edges 12a. One IC carrier 16 is stored in each carrier storage area 15, and a floating attachment state is achieved using fasteners 17 on the two attachment pieces 14. There are approximately 16 x 4 IC carriers 16 attached to each test tray TST.

[0008] The contours of IC carriers 16 have the same shape and same dimensions, and IC components are stored in IC carriers 16. IC housing unit 19 is a rectangular recess in this example. At both ends of IC carriers 16 are formed a hole 21 for attachment to attachment piece 14 and a hole 22 for insertion of a positioning pin.

[0009] To prevent skewing or projection of the ICs within IC carriers 16, a latch 23 is attached to IC carrier 16, for example, as shown in figure 10. For latch 23, latch 23 projects upward from the bottom surface of IC housing unit 19, and using the elasticity of the resin material that forms the IC carriers 16, when an IC component is housed in IC housing unit 19, or when it is removed from IC housing unit 19, the IC housing or removal is performed after opening a space between two latches 23 with latch release mechanism 25 that moves at the same time as IC suction pad 24 that suctions the IC component. When latch release mechanism 25 is removed from latch 23, the latch returns to its original state due to elastic force, and the housed ICs are held in a latched state by latch 23.

[0010] IC carrier 16 holds IC pin 18 exposed on the bottom surface as shown in figure 11. With test head 104, this exposed IC pin 18 is pressed against socket contact 19, and the IC is electrically contacted with the test head. To do this, a pressure element 20 that

presses the IC downward is provided on top of test head 104, and this pressure element presses each IC housed in each IC carrier 16 from above and puts it into contact with test head 104.

[0011] The number of ICs that can be connected to the test head at one time is as shown in figure 12, for example, testing four columns (diagonal line area) of ICs at a time aligned 4 to a row and 16 to a column every four columns. Specifically, the first time, the 16 ICs aligned in columns 1, 5, 9, and 13 are tested, the second time, test tray TST moves by one column and tests ICs aligned in columns 2, 6, 10, and 14, and this is repeated four times until all ICs have been tested. Test results are recorded at an address determined by, for example, an ID number on test tray TST and by an IC number allocated within the test tray TST.

[0012] Provided in unloader unit 400 is a conveyor means 404 that has the same structure as X-Y conveyor means 304 provided in loader unit 300, and already tested ICs from test tray TST carried to unloader unit 400 by this X-Y conveyor means 404 are stacked on general purpose tray KST. In the xample shown in figures 7 and 8, eight stockers STK-1, STK-2, ..., STK-8 are provided in stocker 202 for already tested ICs, showing an example with a structure that allows storage divided into up to eight types according to the test results. Specifically, in addition to dividing good items and defective items, there can also be classifications such as, among good items, items with fast, medium, and slow operating speeds, or among defective items, items for which re-testing is required. Even if the maximum number of dividable categories is eight, only four general purpose trays can be placed in unloader unit 400. Because of this, in the past, when an IC of a category ther than the category allocated to the general purpose tray KST placed in unloader unit 400 is generated, one general purpose tray KST from unloader unit 400 is returned to IC storage area 200, and in place of this, a general purpose tray KST for storing the newly generated category IC is transferred t unloader unit 400, and the IC is stored in that tray.

[0013] [Problems the Invention Attempts to Solve] In the working examples described above, test head 104 is placed underneath the conveyance surface of test tray TST. There is the disadvantage that the height of th overall test device is high because the test head 104 has height and then th upper surface f this test head 104 is the conveyance path of test tray TST, and loader unit 300 and unloader unit 400 are placed n top of this test tray TST conveyance path.

[0014] Because of this, a structure has been considered whereby test head 104 is placed facing downward and the bottom side f test head 104 is used as the test tray TST conveyance path. However, with this kind of structure, test head 104 itself is placed at a relatively high position, so the work of pulling test head 104 outside the device becomes risky.

[0015] Specifically, test head 104 has to change the IC socket that matches each IC terminal pin with each change of the IC to be tested. To do this, test head 104 is supported to be able to be pulled outside the device. In fact, because test head 104 is heavy, the work of pulling the test head 104 which is mounted at a high position to outside the IC testing device is a risky task.

[0016] The goal of the present invention is to provide an IC testing device for which the overall height of the IC testing device is low and that can perform the work of pulling out the test head easily.

[0017] [Means to Solve the Problems] With the present invention, the structure is such that the contact surface of the test head with the IC is mounted in a vertically standing position, and to pull this outside the device, the test head is exposed to the outside in a position facing upward by bending the top side of the test head facing the outside of the IC testing device, so that IC socket replacement can be done easily, and the IC to be tested is made to contact the test head which is in a vertically standing position, so a first position conversion means that converts the test tray which is in a horizontal position to a vertical position is provided between the loader unit and the constant temperature bath, and a second position conversion means that converts the test tray that is in a vertical position to a horizontal position is provided between the heat removal bath and the unloader unit.

[0018] [Effect] With the structure of the present invention, the test head is mounted such that its contact surface with the IC is in a vertically standing position, and the test tray that faces opposite that contact surface is conveyed in a vertically standing position as well, so it is possible to place both the test head and the test tray conveyance path in a low position. Therefore, it is possible to make the height of the IC testing device l wer.

[0019] The contact surface f the test head and the IC is mounted in a vertically standing position, so by pulling to the outsid from this position, it is possible

to expose this to the outside of the device in a position where the contact surface with the IC is facing upward. As a result, there is the advantage that the work of pulling the test head outside the device is easy.

[0020] [Preferred Embodiments of the Invention] We will give a detailed explanation of preferred embodiments of the present invention using the working examples shown in figures 1 through 4. Figure 1 gives an overview of the conveyance path of test tray TST. Items A, B, and C in figure 1 show the status with test tray TST positioned outside chamber 100 shown in figures 7 and 8. Therefore, the test trays TST placed in positions A, B, and C are in a horizontal position, and IC sorting and stacking is performed. For example, A and B are used as unloader unit 400 and C is used as loader unit 300. When ICs to be tested are stacked by loader unit 300, test tray TST is converted to a vertical position by first position conversion means 310. Also, when test tray TST is converted to a vertical position, the ICs are held by latch 23 which is explained using figure 10.

[0021] Test tray TST for which the position was converted is moved downward in a state grasped at first position conversion means 310 and inserted into the constant temperature bath. The state inserted in the constant temperature bath is shown by D. The desired heat stress is given at the constant temperature bath, and then the tray is moved to the test chamber by belt conveyor means 307. In the test chamber, test tray TST is made to contact test head 104 with the tray left in a vertical position, and the ICs to be tested undergo testing (position E). After testing ends, test head 104 is carried to the heat removal bath left in a vertical position (position F). At the heat removal bath, the heat stress given at the constant temperature bath is removed, and the IC temperature is returned to room temperature.

[0022] Second posiiion conversion means 311 is placed in the heat removal bath, the tray is grasped at second position conversion means 311 and carried out in an upward direction, and in a state output to the top of the heat removal bath, the tray is converted to a horizontal position and returned to position A. In this way, by using a structure whereby within the chamber, test tray TST is held in a vertical position and made to contact test head 104, it is possible to place the conveyance path position f test tray TST near floor surface 312 as shown in figure 2. As a result, height H of the testing device can be mad l wer. Also, if test head 104 is bent toward the outside of the device by supporting it to rotate freely with axis 313 as the support point, it is possible to expose the contact surface of test head 104 to the outside of the device with this surface facing upward.

[0023] Figures 3 and 4 show an example of first and second position conversion means 310 and 311. Test tray TST that was sent to loader unit 300 is held down and grasped to chuck 314 of first position conversion means 310. Chuck 314 is driven by clamp cylinder 315, and this grasps one edge of test tray TST. Clamp cylinder 315 is equipped with rod 316, and with rod 316 extended, test tray TST is grasped by chuck 314.

[0024] Clamp cylinder 315 is supported by rotary cylinder 317. Rotary cylinder 317 is supported by vertical lifting and lowering means 318, and can be moved vertically. As shown in figure 4, at loader unit 300, test tray TST is supported by movable rail 319. Movable rail 319 is supported to move forward and backward freely by air cylinder 320.

[0025] Specifically, when test tray TST is grasped by first grasping means 310, air cylinder 320 pulls movable rail 319, and moves from test tray TST in a supported state to the outside. Test tray TST can be rotated freely when this movable rail 319 moves to the outside. Therefore, in this state, by rotating rotary cylinder 317 by 90 °, test tray TST is converted to a vertical position as shown by the dotted line in figures 2 and 4.

[0026] By moving vertical lifting and lowering means 318 downward as shown in figure 3 with test tray TST in a state converted to a vertical position, it is possible to insert test tray TST into the constant temperature bath. Also, vertical lifting and lowering means 318 can be operated linearly by a screw-nut mechanism using a screw shaft, for example. A belt type conveyor means 321 is provided inside the constant temperature bath. A holding means 322 that supports test tray TST in a vertical position is continuously equipped in this conveyor means 321, and test tray TST is supported in a vertical position on this holding means 322 and moved. When the tray is moved from position D1 (figure 4) to position D2 by conveyor means 321, holding means 322 is positioned to match this position D2 and a guide rail for guiding test tray TST to test head 104 is installed, test tray TST is pressed to this guide rail by belt conveyor means 307 (figure 1) provided on top, and test tray TST is sent to the test chamber.

[0027] In the test chamber, test tray TST is pressed against test head 104, an air cylinder, for example, is provided (n t specifically illustrated), and an operation of pressing the ICs housed in test tray TST against test head 104 is performed as shown in figure 11. When all the ICs held in test tray TST are tested by test head 104, test tray TST is again sent toward the heat removal bath 103 by belt conveyor means 307.

[0028] A conveyor means 321 like that shown in figure 4 is also prepared for the heat removal bath, and test tray TST is transferred to second position conversion means 311 in a state with test tray TST held in a vertical position. Second position conversion means 311 grasps test tray TST that is in a vertical position within the heat removal bath, and the position of test tray TST is converted to a horizontal position in the position when test tray TST that moves upward is pulled to the top of the heat removal bath. When test tray TST is converted to a horizontal position, test tray TST that is in a horizontal position and for which the same movable rail 319 projects as shown in figure 4 is supported. In this supported state (position A), test tray TST is moved to position B, and at position B, ICs on test tray TST are sorted according to test results and output to a general purpose tray. The sorting work can also be done at position A.

[0029] Figures 5 and 6 show a variation example of the present embodiment. With this example, an example is shown with a structure whereby the test tray TST circulates in and out of chamber 100 with the test tray left in a vertical position. In this case, a horizontal recess is provided between heat removal bath 103 and constant temperature bath 104, test tray TST is exposed to the outside at this recess, ICs are removed from the test tray TST in this exposed state, and stacking work is performed. In the example in figure 5, the dimensions of the recess were set so that only one test tray TST is exposed, but it is also possible to expose multiple test trays TST, with one actually used for unloader unit 400 and the other used for loader unit 300.

[0030] Figure 6 shows the structure of a vacuum suction head drive device that executes stacking and removal of ICs when using the method shown in figure 5. At the ceiling plane f the device is mounted Y arm 330 that can move in the Y direction, and on this Y arm 330 is mounted an X arm 331 that can move in the X direction. X arm 331 extends downward, and movable head 332 is mounted on X arm 331. Therefore, movable head 332 moves in the Z direction (up-down direction) along X arm 331.

[0031] Vacuum suction head 333 is mounted to rotate freely on movable head 332. Specifically, at a position facing opposite general purpose tray KST, the vacuum suction head is in a downward facing position, and the operation of suctioning the ICs to be tested from general purpose tray KST or of dropping already tested ICs onto the general purpose tray KST is performed. At a position facing opposite the test tray TST that is in a vertically standing position, vacuum suction head 333 rotates horizontally by 90 °, and the ICs pulled up from the general purpose tray KST are mounted on the test tray TST. Or, the ICs mounted on test tray TST are removed, and the operation of dropping them onto a general purpose tray KST according to the test results is performed.

[0032] By using this kind of structure, the test tray TST conveyance path can be placed near floor surface 312. As a result, it is possible to make the overall height H of the device lower. It is also possible to place the position of test head 104 in a low position.

[0033] [Merits of the Invention] As described above, with the present invention, an IC testing method is used whereby test tray TST in a vertically standing position is made to contact test head 104 to test ICs, making it possible to make the position of the test tray TST conveyance path lower. Test head 104 is also placed adjacent to the conveyance path of test tray TST, making it possible to install test head 104 directly on the floor surface of the device. As a result, it is possible to install test head 104 at a low position, giving the advantage that it is possible to perform the work of pulling test head 104 outside the device safely.

[Brief Description of the Figures]

[Figure 1] This is a schematic line drawing for explaining one embodiment of the present invention.

[Figure 2] This is a diagram that shows the status of figure 1 seen from the side.

[Figure 3] This is a diagram for explaining the structure of the position conversion means used for the embodiment shown in figure 1.

[Figure 4] This is a diagram of figure 3 seen from the side.

[Figure 5] This is a schematic line drawing for explaining another embodiment of the present invention.

[Figure 6] This is a diagram of figure 5 seen from the side.

[Figure 7] This is a schematic linear planar diagram for explaining the prior art.

[Figure 8] This is an oblique diagram for explaining the prior art.

[Figure 9] This is an exploded oblique diagram for explaining the structure of a test tray.

[Figure 10] This is an oblique diagram for explaining the structure of the IC housing unit mounted on the test tray.

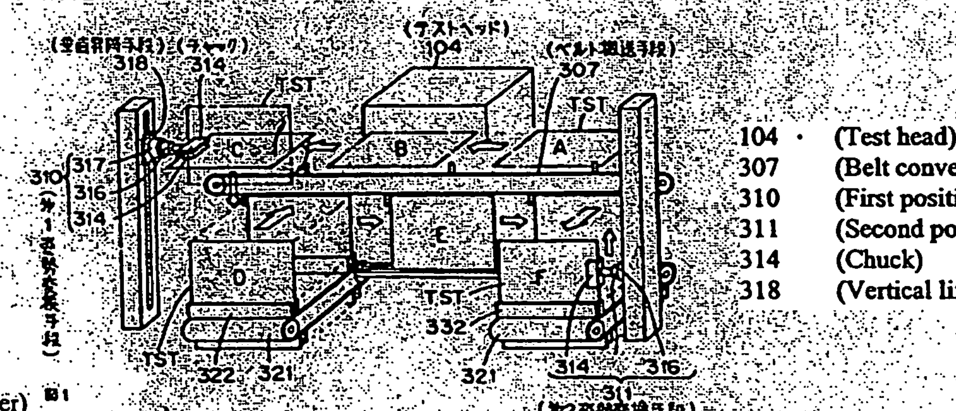
[Figure 11] This is a cross section diagram for explaining the connection status of the ICs held in the test tray and the test head.

[Figure 12] This is a planar diagram for explaining the test sequence of the ICs held in the test tray.

[Key]

101	Constant temperature bath
102	Test chamber
103	Heat removal bath
104	Test head
200	IC storage area
201	Stocker for ICs to be tested
202	Stocker for already tested ICs
300	Loader
310	First position conversion means
311	Second position conversion means
400	Unloader
KST	General purpose tray
TST	Test tray

Figure 1



104	(Test head)
307	(Belt conveyor means)
310	(First position conversion means)
311	(Second position conversion means)
314	(Chuck)
318	(Vertical lifting and lowering means)

100	(Chamber)
101	(Constant temperature bath)
102	(Test chamber)
103	(Heat removal bath)
104	(Test head)

Figure 5

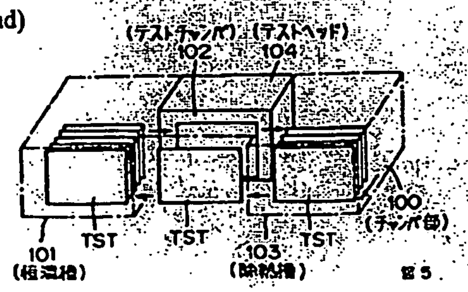
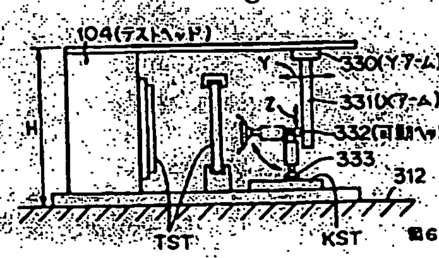
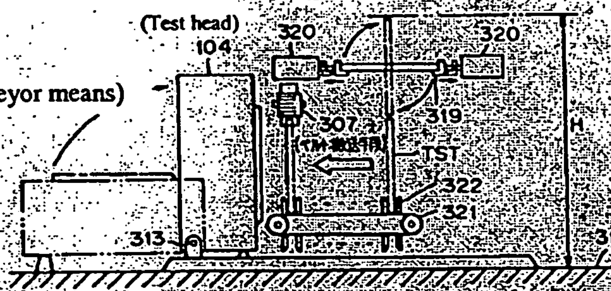


Figure 6



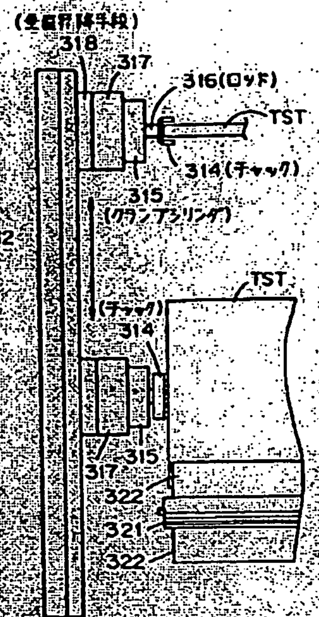
104	(Test head)
330	(Y arm)
331	(X arm)
332	(Movable head)

Figure 2



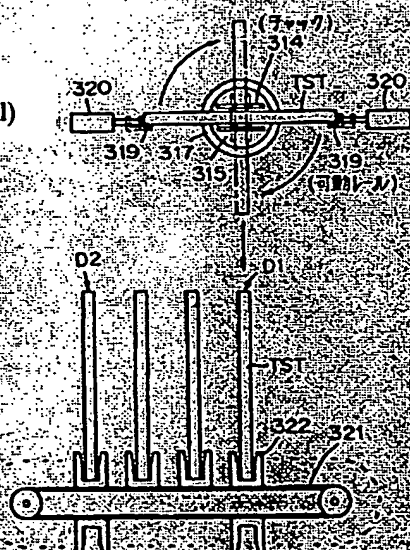
307 (Belt conveyor means)

Figure 3



314 (Chuck)
315 (Clamp cylinder)
316 (Rod)
318 (Vertical lifting and lowering means)

Figure 4

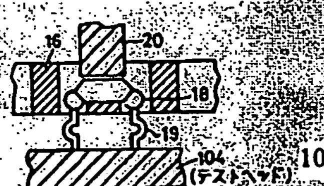


314 (Chuck)
319 (Movable rail)

Figure 10

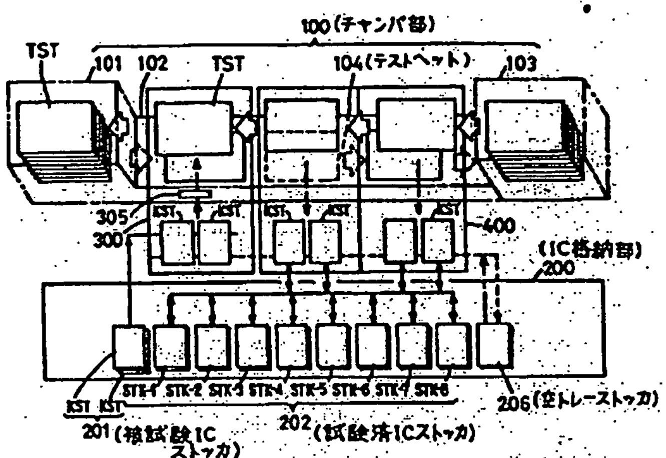
23 Latch
24 IC suction pad
25 Latch release mechanism

Figure 11



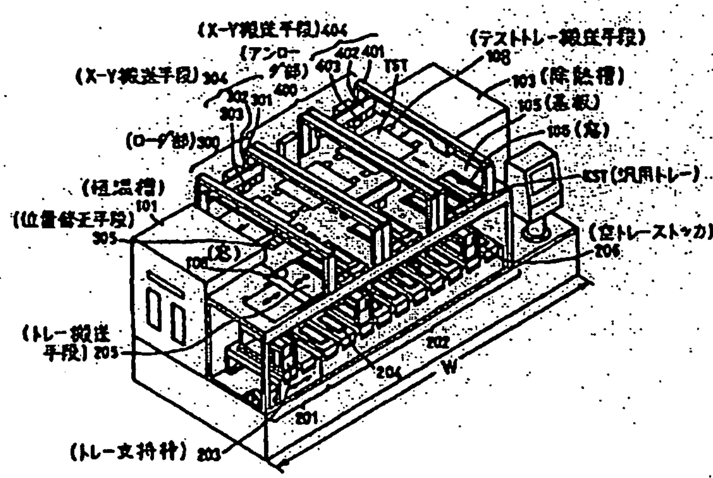
104 (Test head)

Figure 7



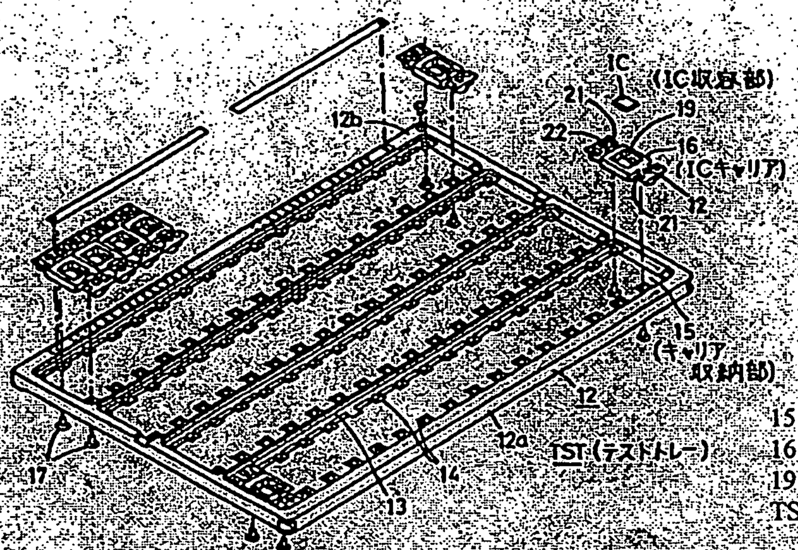
100	(Chamber)
104	(Test head)
200	(IC storage area)
201	(Stocker for ICs to be tested)

Figure 8



101	(Constant temperature bath)
103	(Heat removal bath)
105	(Substrate)
106	(Window)
108	(Test tray conveyor means)
203	(Tray support frame)
205	(Tray conveyor means)
206	(Stocker for empty trays)
300	(Loader)
304	(X-Y conveyor means)
305	(Position correction means)
400	(Unloader)
404	(X-Y conveyor means)
KST	General purpose tray

Figure 9



15 (Carrier storage area)
16 (IC carrier)
19 (IC storage area)
TST (Test tray)

Figure 12